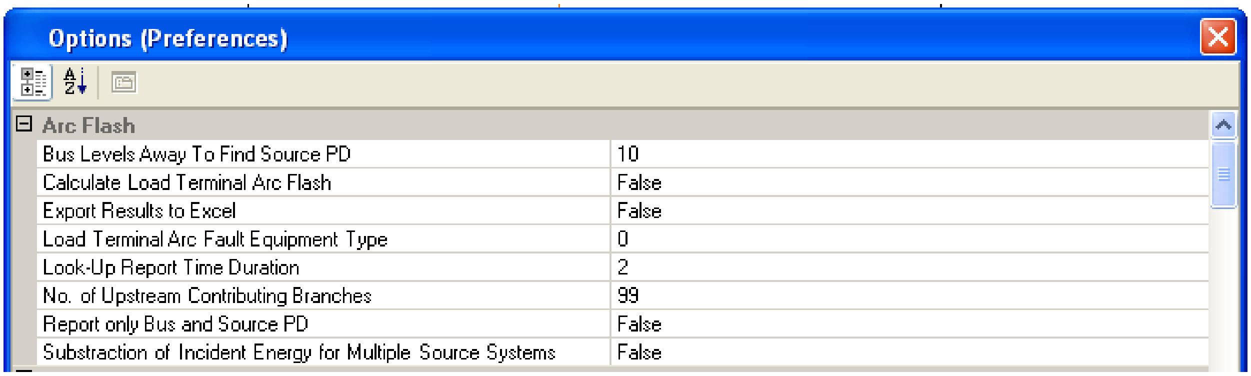
Arc Flash Exercise 2 – Solutions

Purpose & Description

The purpose of this exercise is to perform an arc flash calculation for a low voltage system protected with power and molded case circuit breakers. This exercise also helps to illustrate the use of different configurations, scenarios and system grounding, which should be considered in order to find the most conservative solution.

Setup

Load the project file named "Arc Flash Example2". The solution to this example is located in a directory called "Solution". Open the solution project only to compare against your exercise once completed. Please make sure to have the following Options (Preferences) selected prior to beginning this exercise:



Options (Preferences)

Arc Flash

Bus Levels Away To Find Source PD	10
Calculate Load Terminal Arc Flash	False
Export Results to Excel	False
Load Terminal Arc Fault Equipment Type	0
Look-Up Report Time Duration	2
No. of Upstream Contributing Branches	99
Report only Bus and Source PD	False
Substraction of Incident Energy for Multiple Source Systems	False

Procedure

Step1

Create the following configurations in addition to the existing "Normal OP":

Configuration ID	Element Status
EDG Online	• CB15 = open • 2SW1 = PosA • Gen1 = Swing Mode • Utility = Voltage Control Mode • All other PDs are normally closed • All remaining loads are in continuous status
Both Online	• CB15 = closed • 2SW1 = PosA • Gen1 = Voltage Control Mode • Utility = Swing Mode • All other PDs are normally closed • All remaining loads are in continuous status

Step2

Open the Short-circuit study case named "AF LV" and make the following selections from the Arc Flash page:

- Bus Fault Current = Symm. ½ Cycle
- System Grounding = "One-Line Diagram"

- Check the Update Buses boxes for Fault Currents, FCT and Grounding

Make the following selections from the Info Page:

- Fault Buses: “Bus11”, “Mtr5 Term”, “Mtr7 Term” and “Mtr8 Term”.

Step3

Setup the following scenarios using the “Scenario Wizard” tool.

Configuration ID	Element Status
Scenario1	• System = Network Analysis • Presentation OLV1 • Revision Data = Base • Config. Status = **Normal OP** • Study Mode = Short-circuit • Study Type = ANSI Arc Flash • Study Case = AF LV • Output Report = “Normal OP” (Type in the report name)
Scenario2	• System = Network Analysis • Presentation OLV1 • Revision Data = Base • Config. Status = **EDG Online** • Study Mode = Short-circuit • Study Type = ANSI Arc Flash • Study Case = AF LV • Output Report = “EDG Online” (Type in the report name)
Scenario3	• System = Network Analysis • Presentation OLV1 • Revision Data = Base • Config. Status = **Both Online** • Study Mode = Short-circuit • Study Type = ANSI Arc Flash • Study Case = AF LV • Output Report = “Both Online” (Type in the report name)

Step4

Run each of the previous three scenarios and answer the following questions:

4.1 Enter the fault clearing time, Source Protective Devices as shown on the Arc Flash page of “Bus11” for every scenario. Record them in the following table.

Scenario ID	Fault Clearing Time (FCT)	Source Protective Device	Incident Energy (cal/cm^2)
Scenario1 (Normal)	3.6 cycles	CB15	2.4
Scenario2 (EDG)	10.8 cycles	CB1	2.6
Scenario3 (Both)	12 cycles	CB1	9.3

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4.2 What scenario results in the highest amount of incident energy release in the event of an arc fault at "Bus11" (not the line side of Source Protective Device feeding this bus) and why?

Scenario 3 (Both Online because there are two sources connected).

4.3 Scenarios 2 and 3 result in similar fault clearing times. Explain why Scenario 3 produces a much higher incident energy value?

Because there are two sources feeding the fault. The conservative approach taken by the program to determine the energy takes the total arcing current up to the time of the last protective device to operate.

4.4 What is the system-calculated grounding configuration determined by the program for Scenarios 1 and 3?

Grounded, as long as there is a solidly grounded source.

4.5 Why is the system-calculated grounding configuration of scenario 2 different from that of scenario 1 and 3?

Scenario 2 results in an ungrounded configuration because the EDG is not solidly grounded. IEEE 1584 indicates this.

4.6 If you change the grounding of the generator to Wye solidly grounded what is the percent change in the calculated incident energy?

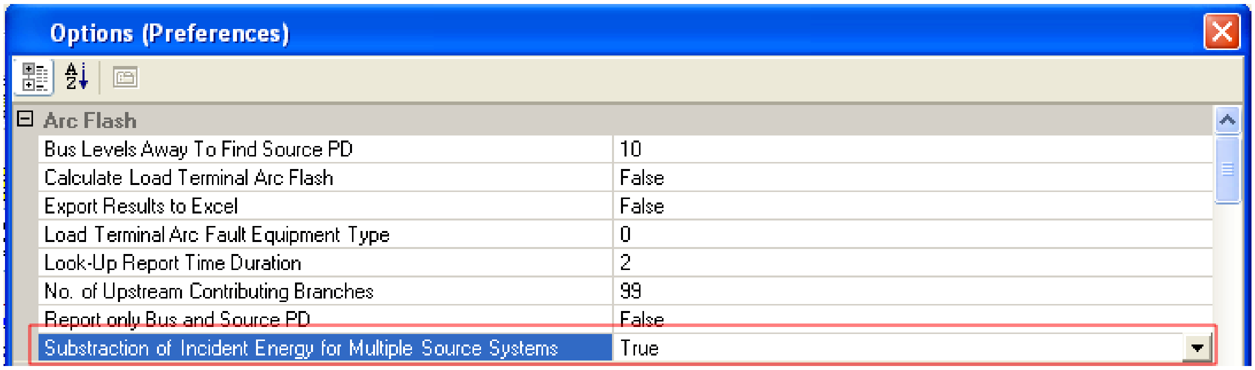
About 23% since the solidly grounded configuration of the EDG would now cause a smaller value of 2.01 cal/cm^2.

4.7 If you do not know the details of the grounding configuration of the system, how can you configure ETAP to produce conservative incident energy results?

User-defined grounding with all buses set to "Ungrounded".

Step5

Go to the Options (Preferences) editor and make the following change:



Bus Levels Away To Find Source PD	10
Calculate Load Terminal Arc Flash	False
Export Results to Excel	False
Load Terminal Arc Fault Equipment Type	0
Look-Up Report Time Duration	2
No. of Upstream Contributing Branches	99
Report only Bus and Source PD	False
Substraction of Incident Energy for Multiple Source Systems	True

The Incident energy subtraction method will enable the program to remove the energy from each source as it operates to de-energize the fault.

Please note that you should return the grounding configuration of the EDG back to resistor grounded.

5.1 Re-run all scenarios using this new setting. Which scenarios show differences in the results?

Scenario 3 should be the only one with a change since it has two sources operating for a closed loop transition.

5.2 Which source provides most of the energy for a fault at Bus11?

Source CB15 (utility source) provides much of the energy to the fault. Once removed, the energy remaining is small.

5.3 Repeat Scenario3 using the fault current decay method. Assume that the generator will contribute only 150% of Gen rated FLA for a sustained fault. Also assume a Maximum FCT of 2.0 sec. What is the difference in the incident energy and fault clearing time?

The generator may not have enough current contribution to trip the fault. You may need to select a smaller size breaker (400 Amps) to better coordinate with the generator decrement curve.